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Research Article

Reasons for 2 Or 3 Surfaces Amalgam Replacements in a Teaching Hospital in Nigeria

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Abstract: ***Aim:*** The objective of this study is to evaluate clinically the reasons given for amalgam failure and subsequent replacements to avoid the pitfalls and issues concerning the failure of such restorations so that the restoration may have longer longevity and consequently greater success. ***Material And Method:*** The record file is the material used for the study and this record of treatment extracted from the records, with a regular attendee defined, record of α, 3 or 4 surfaces extracted and those regular attendees recalled for a cross-examination purposes to determine their inclusion or not in the study. There is also a set of inclusion criteria to be followed. ***Results:*** Fractured amalgam restorations, marginal fracture/Ditching, Recurrent caries, dislodged amalgam restoration, cervical overhang of amalgam restorations, fractured cusp and iatrogenic causes were listed as the reasons given for amalgam failure and consequent replacements. All 2, 3, 4 surfaces restorations were grouped together and fractured amalgam restoration amounted to 23 (70.9%), Marginal fractures/ditching 45 (13.5%), recurrent caries 30 (9.0%), Dislodged amalgam restoration 10 (3.0%), cervical overhang of amalgam restoration 8 (2.4%) and fractured cusp 4 (1.2%). The study was subjected to gender test and the same order was seen. In females fractured amalgam restoration formed (46.8%) of all the restoration, marginal fracture/Ditching 8.1% (27), Recurrent Caries 6.0% (20), Dislodged amalgam restoration 0.9% (03) and cervical overhanging amalgam restoration was 2.1% (07) fractured cusp was 0.6% (02) while male amalgam restoration accounts for 24% (80),, Ditching 5.4% (18) Recurrent caries 3.0% (10), dislodged amalgam restoration 2.1% (07) and cervical oveehanging 0.3% (01) and fractured cusp 0.6% (02). When the results of the study for replacement of amalgam was pooled together for all gender fractured amalgam restoration, marginal defect (Ditching, Recurrent caries, Dislodged amalgam restoration and Cervical overhang of amalgam and fractured cusp occurred in that descending order accounting for 70.9%. 13.5%, 9.0%, 3.0%, 2.4%, 1.2%, respectively. The pattern was repeated when the reasons given for replacement of amalgam restorations was analysed by operator effect in the descending order of fractured amalgam restoration 236 (70.9%) , Ditching 45 (13.5%), Recurrent caries 30 (9.0%), Dislodged amalgam restoration 10 (3.0), cervical overhanging amalgam restoration 08 (2.4%), fractured cusp 4 (1.2%). ***Discussion:*** fractured amalgam restoration was the major reason given for the replacement of multi-surface amalgam restoration in this study unlike in other studies conducted in Europe, America where the major reason for replacement was fractured cusp and recurrent caries. In these developing economies especially Nigeria recurrent caries was mot a major problem as regards the replacement of multi-surface amalgam restoration. Both gender and operator effect did not change the reasons for replacement of amalgam restorations. ***Conclusion:*** Fractured amalgam restoration was the major reasons for replacement of multi-surface amalgam restoration while marginal fracture/Ditching was the second most given reason which shows that the types of material used maybe important in the restoration of carious cavities.

Keywords: Ditching, Fractured amalgam, Gender, Multi-surface restoration, Operator, Recurrent Caries, Replacement

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INTRODUCTION

Dentists generally spend most times treating caries whilst operative dentistry is significantly involved in the area of placement of restorations and most especially placing or replacing direct restorations all of which evidence abound that the survival time is limited because some extraneous factors like operator variables, patient attitudes and actions to and on the restoration and the properties of the material used for the restoration (Lucarotti, P. S. K. *et al.*, 2005a; Burke, F. J. T. *et al.*, 2005; Lucarotti, P. S. K. *et al.*, 2005b; & Hickel, R., & Manhart, J. 2001).

It is also a known fact that replacement of failed restoration tends to lead to the likelihood of tooth

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tissue loss with each intervention with a resultant weakened tooth.

An estimated 50% of restorative work carried out by dentist account for the management of failed restoration (Mjör, I. A. *et al.*, 2002).

Some studies have shown that there is operator related, restoration related and patient related factors influencing the outcome of treatment and most especially the failure and replacement of restorations (Mjör, I. A. *et al.*, 2002; & Deligeorgi, V. *et al.*, 2001). Therefore dentists spend much of their clinic time replacing deficient restorations (Mjör, I. A., & Ryge, G. 1981; Elderton, R. J., & Davies, J. A. 1984; Maryniuk, G. A. 1984; Maryniuk, G. A., & Kaplan, S. H. 1986; Burke, F. J. *et al.*, 1999; Forss, H., & Widström, E. 2004; Setcos, J. C. *et al.*, 2004; & Fernández, E. M. *et al.*, 2011).

In the last decades many studies have been conducted on reasons for the replacement of restorations, those data has limitations but it helps in broadening the knowledge and understanding the pattern of success and failure of those restorations.

The reasons for restoration replacement and the age of replaced restorations would provide useful guidance on treatment planning and future material development (Tyas, M. J. 2005).

The replacement of restoration invariably results in the enlargement of the cavity design leading to tooth weakening.

Various reasons have been adduced to failure and therefore replacement of amalgam restoration part of which but not limited to secondary caries, fractured tooth or cusps either functional or non-functional, fractured restoration, defective/marginal failure, marginal discolouration, cervical overhang of amalgam, dislodge restoration.

The aim of this study is to see the distribution of these reasons and if it follows the same pattern or not while gender and type of operator distribution would also be analysed.

MATERIAL AND METHOD

The record of patients was gone through for a 14year period collecting data such as age, sex and records of treatment. All the patients that were referred to the Conservative Dentistry Clinic were selected and those treated were recorded in a separate book giving each patient a serialised number. For those that were treated, they were classified as those that visited their dentist twice in a year but because of the peculiarities of Nigerian patient , regular attendees was defined as someone who visited his or her dentist once in 2years in a 5 years period.

Then the number of patients who fulfilled these criteria was recalled for the purpose of cross examination to see;

- If the records in the mouth tallies with the records of the patient
- If the records did not tally, to find out if the patient had attended any other clinics for dental treatment
- If the answer to (ii) above is true, if the patient would remember the procedure done on him/her
- If the patient could not remember or recall the type of treatment then the patient is eliminated from the study
- If the break in the patient attendance was more than 2 years, the patient is eliminated from the study

The reasons for the replacement of amalgam restoration were collated and grouped under the following headings;

- Fractured amalgam restoration
- Marginal fracture/Ditching
- Recurrent caries
- Fractured tooth
- Dislodged amalgam restoration
- Cervical overhang of amalgam
- Iatrogenic preparation
- Others – Attrition,

RESULTS

The study revealed that 2-surfaces amalgam replacement can be categorised into class II Mesio-occlusal amalgam restorations, class II Disto-occlusal amalgam restorations and class II Mesio-occlusaldistal amalgam restorations.

For class II MO restorations there are sub-categorisation

- Class II MO with buccal extensions
- Class II MO with palatal/lingual extensions
- Class II MO with cuspal restorations

For Class II DO restorations there are similar nomenclatures

- Class II DO with buccal extensions
- Class II DO with palatal/lingual extensions
- Class II DO with cuspal restorations

For Class II MOD, there are also found to be similar situation of modifications

- Class II MOD with buccal extensions
- Class II MOD with palatal/lingual extensions
- Class II MOD with cuspal restorations

Due to the fact that the 3-surfaces amalgam restoration was very few in number, it was decided that for easier analysis, it should be lumped together with

the 2-surfaces amalgam restoration, and termed multisurface amalgam restoration

TABLE I: Frequency of Replacement by Sub-Class of Restoration

		TOTAL NO	% OF REPLACEMENT
CLASS II	Class II (MO) Mesioocclusal	121	36.3
	Class II (D)) Distoocclusal	144	43.2
	Class II(MOD) Mesioocculusaldistal	68	20.4
		333	

Table I shows that distribution of both 2 and 3 surfaces amalgam restorations with their respective modifications which amounted to 333 amalgam restorations.

Class II MO accounted for 36.3% (121 amalgam restoration), DO was 43.2% (144 restoration) and MOD 68 restoration (20.4%) of all restorations replaced in this study.

TABLE II: Replacement Carried Out For Class II

REASONS FOR REPLACEMENT	NUMBER OF RESTORATION REPLACED	% OF TOTAL
Fractured Restoration	236	70.9
Marginal Fracture/Ditching	45	13.5
Recurrent Caries	30	9.0
Dislodged Restoration	10	3.0
Overhanging Cervical Restoration	8	2.4
Fractured Cusp	4	1.2
TOTAL	**333**	

Table II shows that distribution of reasons given for restoration replacement which was fractured restoration amounted to 236 restorations (70.9%), marginal fracture/Ditching 45 restorations (13.5%), Recurrent caries amounted to 30 restorations (9.0%), Dislodged restoration 10 (3.0%), cervical overhanging amalgam restoration 8 (2.4%), fractured cusp 4 (1.2%)

TABLE III: Frequency of Reason for Amalgam Restoration Replacement by Gender

	F	%	M	%	TOTAL	%
Fractured Amalgam Restoration	156	63.6	80	36.4	236	70.9
Column %	72.6		67.8			
Defective Margin/Ditching	27	60.0	18	40.0	45	13.5
Column %	12.6		15.3			
Recurrent Caries	20	66.7	10	33.3	30	9.0
Column %	9.3		8.5			
Dislodged Amalgam Restoration	03	30.0	07	70.0	10	3.0
Column %	1.4		5.9			
Cervical Overhanging Amalgam	07	87.5	01	12.5	08	2.4
Column %	3.3		0.8			
Cusp Fracture	02	50	0.2	50.0	04	1.2
Column %	0.9		1.7			
	215	**64.6**	**118**	**35.4**	**333**	**100%**

The reasons given for replacement of amalgam restorations or the reasons for failure of the initial restoration placed when considered along gender line for both genders were fractured amalgam restoration 236 (70.9%), defective amalgam margins 45 (13.5%0, Recurrent caries 30 (9.0%), Dislodged amalgam restoration 10 (3%), Cervical overhanging amalgam restoration 8 (2.4%), Cusp fracture 4 (1.2%). When analysed according to different gender fractured amalgam restoration formed 63.6% in female while male was 36.4% when it is considered against the backdrop of the whole restoration, fractured amalgam restoration in female forms 46.8% while male accounted for 24.0%. Considering marginal fracture/Ditching female accounted for 8.1% of all replaced amalgam restoration while male accounted for 5.4%. Recurrent caries in female was seen in 20 cases representing 6.0% while males amounted to 10 cases (3.0%). For Dislodged amalgam restoration 3 was recorded for females while 7 for males representing 0.9% and 2.1% respectively. Overhanging amalgam was recorded in females in 7 cases and in male once representing 2.1% and 0.3% respectively. As for fractured Cusp given for the reason for replacement it was only found twice in both male and female representing 0.6% in both genders. (Table III).

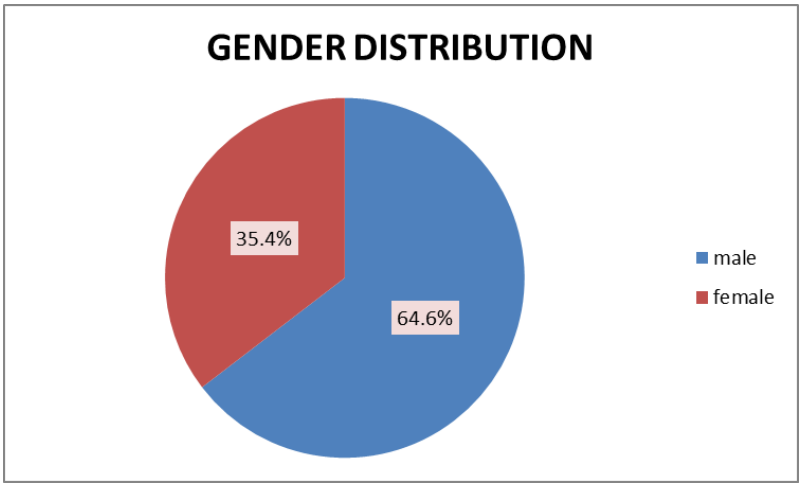

Fig. 1. Gender Distribution

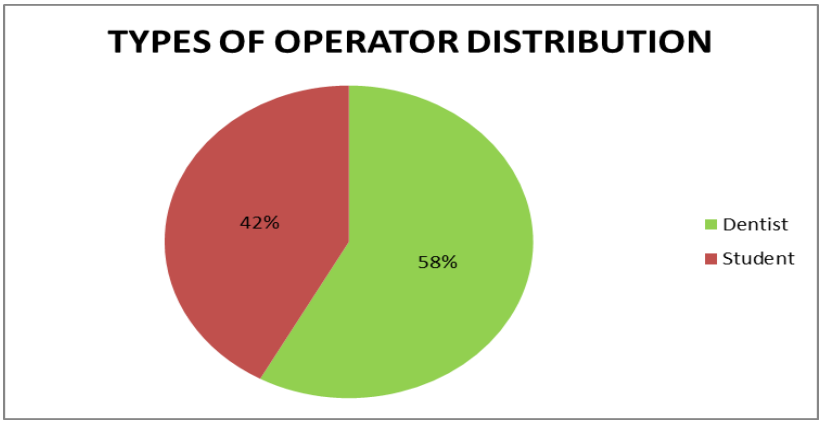

Fig. 2. Types of Operator distribution

Fig 1 shows the distribution of amalgam restoration along gender lines.

Fig 2 showed the distribution between the operators as this is a Teaching Hospital Centre where dental students are allowed to see and treat patients as one of the requirements to be fulfilled before the final professional examination and one of those procedures are Classes I-V amalgam restoration especially Class II.

TABLE IV: Distribution for Class Ii Amalgam Replacement by Type of Operator

	Dentists Column %	No Of Restoration	Students Column %	Number Of Restorations	Total	% Total
Fractured Amalgam Restoration	70.59%	136 (57.6%)	71.4	100 (42.4%)	236	70.9%
Defective Margin/Ditching	13.0%	25 (55.6%)	14.3	20 (49.4%)	45	13.5%
Recurrent Caries	8.8%	17 (56.7%)	9.3	13 (43.3%)	30	9.0%
Dislodgedamalgam Restoration	3.1%	6 (60%)	2.9	4 (40%)	10	3.0%
Cervical Overhanging Amalgam	2.6	5 (62.5%)	2.1	3 (37.3%)	8	2.4%
Cusp Fracture	2.0	4 (100%)	-	-	4	1.2%
		193 (58%)		**140 (42%)**	**333**	**100%**

Table IV showed the distribution of reasons for replacement of amalgam restoration in different operators.

Different operators have degree of varying skills and capacities, 58% of replaced amalgam restorations was carried out by dentist of different grades while 42% were students operators representing 193 and 140 restorations respectively. As for fractured amalgam restorations 70.9% was the reason given for amalgam replacements, marginal fracture 13.5%, recurrent caries 9.0%, dislodged amalgam restoration 3%, Cervical overhanging amalgam restoration was 2.4% while fractured cusp was 1.2%. However considering the operator types, the dentist accounted for 57.6% while students replaced 42.4%. 55.6% marginal fracture were replaced by dentist while students replaced 44.4%. For the recurrent caries, dentist replaced 56.7% while students 43.3%; for dislodged amalgam restoration 60% was replaced by the dentist while students were responsible for 4%, and for cervical overhang amalgam restoration students replaced 37.5% while dentist replaced 62.5%. For the cusp, only the dentists were involved in amalgam replacement. The dentist were responsible for replacement of fractured amalgam restoration, defective margin/Ditching, recurrent caries, dislodged amalgam restorations, cervical overhanging amalgam restoration and fractured cusp replacement in 70.5%, 13.0%, 8.8%, 3.1% 2.6% and 2.0% cases. The students, however, were responsible for the replacement of fractured amalgam restoration, Ditching, Recurrent caries, dislodged amalgam restoration and cervical overhang of amalgam restoration 71.4%, 14.3%, 9.3% 2.9% and 2.1% respectively. The students were not involved in cuspal restoration of the fractured cusp.

DISCUSSION

This is a study spanning a period of 14years starting with the record of the patients that had attended the dental centre and by extension the Conservative Dentistry Section for treatment Records of replacement of amalgam restoration was extracted and part of the inclusion criteria was constant attendance in the dental clinic which was defined as once in 2 years. The usually accepted standard was attendance to a dental clinic twice in a year but because a study (Olaleye A.O. 1997) showed that most Nigerians do not visit their dentist until severe pains sets in then it was imperative that the definition of regular attendee should be redefined.

In considering the replacement of amalgam restorations, it has been proved that some factors influence the replacement of restorations which are cultural behaviour (Olaleye A.O. 1997) gender, types of restoration, operator type and age (Gruythuysen, R. J. M. *et al.*, 2004; & Plasmans, P. J. *et al.*, 1998).

It is also a fact that an appropriate dental restorative material should withstand 1.5million force cycle in the oral cavity and this would have taken place in 18months (Craig, R. G., & Powers, J.M. eds 2006; & Pouralibaba, F. *et al.*, 2010) it is therefore appropriate with the redefining of regular attendees and because the poverty level in Nigeria does not make room for 3square meals, so it may take more than 18months for the force cycles to be achieved where poverty is high.

The patients so selected were recalled and examination of the mouth carried out to ascertain;

1. If the records of teeth are still intact
2. When it is changed, the reasons for change would be ascertained
    a. If there is any new restoration, where, when should be known by the patient
    b. If there ia any extraction, the reasons must be clarified
    c. If the extraction involved one of the restored tooth, it must be ascertained

when the extraction too place and why

3. If the answer to question 2 above is unclear, the patient is eliminated from the study.

The 2-surface amalgam restoration is easily discernible and it is Mesioocclusal (MO) Distooclussal (DO), while Mesioocclusal Distal is a simple 3-surface amalgam restoration. However, DO's and MO's can have a modification which places them under 3-surfaces restoration such as MO or DO with Ligual/Palatal or Buccal extension has 4-surfaces. The numbers of those modifications were very small so it was wise to simply put them under 2 and 3 surface restoration as a block and termed it as multi-surface amalgam restorations.

Expectedly MOD restorations are fewer in number than MO and DO and the most prevalent cause of failure was fractured restoration unlike the other studies where recurrent caries and cusp fractures dominates (Sarabi, N., Moghaddas, M., & Ghaboolian, T. 2008; & Bernado, M. *et al.*, 2000).

The number of bulk fracture or fractured amalgam restoration is very high in this study,, compared to what is obtainable in Europe and America, it is worrisome that the pattern is different in this study. Therefore, there is need for retraining of the operators and need for advocacy in the practice that may harm the restoration because all the faults may not be traceable to the door steps of the patients. More so, the males, even though, there is less bulk fracture but it still forms the greater reason for replacement of all restorations in males which is 67.8%.

Even though the number of restoration replaced by the clinical dental students was less than dentists, the variation was seen in the number of fractured amalgam restorations. The clinical students usually have requirements to fulfil to qualify for the final professional examinations that did not include replacement of amalgam restorations so the interest to perform replacement may not ginger them to perform the procedure.

All the fractured cusp was replaced by the dentist because it is a complex procedure and the requirement for the workbook did not include construction of fractured cusps.

There is tendency for the clinical students to under-diagnose the presence of secondary caries because they were involved in clerking and diagnosis of the patient in oral diagnosis and naturally the clinical students in Conservative Dentistry may likely follow the diagnosis from oral diagnosis, oral medicine clinic. It may be possible that recurrent caries was there under the restoration before the bulk fractured occurred and may be missed

The order reported in this study was fractured restoration, marginal fracture or ditching, recurrent carries, dislodged amalgam, cervical overhang and lastly insignificantly cuspal fractures. This is unlike the reasons given for replacement of amalgam restoration in developed countries where recurrent caries and cusp fractures were the commonest reasons given.

Fractured restorations could be because as a result of patients factor such as of the force of mastication, not allowing the amalgam set properly before chewing on that side operated upon, and the cultural factors of breaking bone with the teeth (Olaleye A.O. 1997). The operator factors could be in cavity design, isthmus being wider than should be ordinarily and not religiously following the set of rules of retention and resistance forms. In that there might not be adequate depth of restoration, feat and even surface of the lining with occulusal converging form of the cavity. It is also known that the introduction of high copper amalgam alloy increases the strength of the alloy (Craig, R. G., & Powers, J.M. eds 2006; Robertson, T.M. *et al.*, 2006; & Summit, J.B. *et al.*, 2006) however,, the type of alloy used were not specified.

Although it may not be ruled out that alloy of the bulk fracture of amalgam may be due to secondary caries which may not be noticed either because caries were left behind during the primary placement or they arise from marginal defect of amalgam thereby causing a secondary caries but because there was no pain or serious pain, the patient waited long enough for the restoration to fracture under heavy mastication.

CONCLUSION

It is believed that in this part of the world, the reasons given for amalgam restoration failure and consequently its replacement was fractured of amalgam restoration and there is the need to combat it from the patient angle through advocacy on proper post-operative care of any restoration. There is also the need to adapt to the use of copper based amalgam alloy to check the creep and marginal degradation.

There is the need to conduct separate clinical session for all the patients coming newly to the Conservative Dentistry Unit of the Restorative Dentistry Department to correct any anomaly of diagnosis which may skew diagnosis wrongly and ultimately affect research in later years.

Finally the operator should understand the minor pitfall of amalgam restoration by finishing the restoration well. It is also of no use if an operator goes through restorative procedure for it to fail within a short time post procedure, it would have regarded the efforts put in by the operator. This should be the beauty of restorative procedure.

REFERENCE

1. Bernado, M., Luis, H., Martins, M.D., Leroux, B.G., Rue, T., & Leiato, J. (2000). Survival and reasons for failure of amalgam versus composite posterior restoration placed in a randomized clinical trial. *J. Am. Dent. Assoc. 131*, 43-49.
2. Braga, S. R. M., Vasconcelos, B. T., de Paula Macedo, M. R., Martins, V. R. G., & Sobral, M. A. P. (2007). Reasons for placement and replacement of direct restorative materials in Brazil. *Quintessence international*, *38*(4), e189–e194.
3. Burke, F. J. T., Lucarotti, P. S. K., & Holder, R. L. (2005). Outcome of direct restorations placed within the general dental services in England and Wales (Part 2): variation by patients' characteristics. *Journal of dentistry*, *33*(10), 817-826.
4. Burke, F. J., Cheung, S. W., Möhr, I. A., & Wilson, N. H. (1999). Restoration longevity and analysis of reasons for the placement and replacement of restorations provided by vocational dental practitioners and their trainers in the United Kingdom. *Quintessence International*, *30*(4), 234–242.
5. Craig, R. G., & Powers, J.M. eds (2006). Restorative Dental Materials 12th ed. *Chicago: Mosby*, *273*, 295- 298.
6. Deligeorgi, V., Mjör, I. A., & Wilson, N. H. (2001). An overview of reasons for the placement and replacement of restorations. *Primary Dental Care*, (1), 5-11.
7. Elderton, R. J. (1997). Changing the course of dental education to meet future requirements. *Journal (Canadian Dental Association)*, *63*(8), 633-634.
8. Elderton, R. J., & Davies, J. A. (1984). Restorative dental treatment in the General Dental Service in Scotland. *British dental journal*, *157*(6), 196–200.
9. Fernández, E. M., Martin, J. A., Angel, P. A., Mjör, I. A., Gordan, V. V., & Moncada, G. A. (2011). Survival rate of sealed, refurbished and repaired defective restorations: 4-year follow-up. *Brazilian dental journal*, *22*(2), 134-139.
10. Forgie, A. H., Pine, C. M., & Pitts, N. B. (2001). Restoration removal with and without the aid of magnification. *Journal of oral rehabilitation*, *28*(4), 309-313.
11. Forss, H., & Widström, E. (2004). Reasons for restorative therapy and the longevity of restorations in adults. *Acta Odontologica Scandinavica*, *62*(2), 82-86.
12. Gruythuysen, R. J. M., Kreulen, C. M., Tobi, H., Van Amerongen, E., & Akerboom, H. B. M. (2004). 15 year evaluation of Class II amalgam restorations. Oper. Dent, 29:614-622.
13. Hickel, R., & Manhart, J. (2001). Longevity of restorations in posterior teeth and reasons for failure. *Journal of adhesive dentistry*, *3*(1), 45–64.
14. Hunter, A. R., Treasure, E. T., & Hunter, A. J. (1995). Increases in cavity volume associated with the removal of class 2 amalgam and composite restorations. *Operative dentistry*, *20*(1), 2-6.
15. Lucarotti, P. S. K., Holder, R. L., & Burke, F. J. T. (2005). Outcome of direct restorations placed within the general dental services in England and Wales (Part 1): variation by type of restoration and re-intervention. *Journal of dentistry*, *33*(10), 805-815.
16. Lucarotti, P. S. K., Holder, R. L., & Burke, F. J. T. (2005). Outcome of direct restorations placed within the general dental services in England and Wales (Part 3): variation by dentist factors. *Journal of dentistry*, *33*(10), 827-835.
17. Maryniuk, G. A. (1984). In search of treatment longevity--a 30-year perspective. *Journal of the American Dental Association (1939)*, *109*(5), 739-744.
18. Maryniuk, G. A., & Kaplan, S. H. (1986). Longevity of restorations: survey results of dentists' estimates and attitudes. *The Journal of the American Dental Association*, *112*(1), 39-45.
19. Mjör, I. A., & Ryge, G. (1981). Comparison of techniques for the evaluation of marginal adaptation of amalgam restorations. *International dental journal*, *31*(1), 1-5.
20. Mjör, I. A., Shen, C., Eliasson, S. T., & Richter, S. (2002). Placement and replacement of restorations in general dental practice in Iceland. *Operative dentistry*, *27*(2), 117-123.
21. Olaleye A.O. (1997). Longevity and failure patterns of amalgam restorations at the University College Hospital Ibadan, Nigeria 1979-1992. Fellowship of West African College of Surgeons. Thesis WACS Oct. 1997.
22. Plasmans, P. J., Creugers, N.H., & Mulder, J. (1998) Long-term Survival of extensive amalgam restorations. *J. Dent. Res. 77*, 453-460.
23. Pouralibaba, F., Joulaei, M., Kashefimehr, A., Pakdel, F., Jamali, Z., & Esmaeili, A. (2010). Clinical evaluation of reasons for replacement of amalgam restorations in patients referring to a dental school in Iran. *Journal of dental research, dental clinics, dental prospects*, *4*(2), 56-59.
24. Robertson, T.M., Heyman, H.O., & Swift, E.J. eds. (2006). Sturdivants Art and Science of Operative Dentistry 5th ed. Chicago: Mosby, 5, 80, 95, 115, 220, 353, 426.
25. Sarabi, N., Moghaddas, M., & Ghaboolian, T. (2008). One-year clinical assessment of class II amalgam restorations. *Journal of Mashhad Dental School*, *32*(2), 123-128.
26. Setcos, J. C., Khosravi, R., Wilson, N. H., Shen, C., Yang, M., & Mjör, I. A. (2004). Repair or replacement of amalgam restorations: Decisions at a USA and a UK dental school. *Operative Dentistry*, *29*(4), 392.
27. Summit, J.B., Robbins, J.W., Hilton, T.J., Schwarts, R.S., & Santos, J. eds. (2006).

Fundamental of Operative Dentistry: A Contemporary Approcah 3rd ed. *Philadelphia: Quintessence*, 56-106.

28. Tyas, M. J. (2005). Placement and replacement of restorations by selected practitioners. *Australian Dental Journal*, *50*(2), 81-89.